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WADC TECHNICAL NOTE 59-353

A DEVICE FOR MEASURING GROSS MOTOR BEHAVIOR IN PRIMATES

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OCTOBER 1959

WRIGHT AIR DEVELOPMENT CENTER
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

9

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FOREWORD

This device was developed under Project 7183, Task 71620, "Behavioral Effects of Unusual Environmental Conditions," with Major Frederick H. Rohles, Jr., acting as task scientist. Wright-Patterson Air Force Base Shops constructed the device under the direction of Mr. W. F. Lewis. The Technical Photographic Division, Wright Air Development Center, provided for filming the jumps and obtaining and reducing the data from the films. The authors are grateful to these two organizations for their assistance.

The animal experimentation performed in this study was in accordance with American Medical Association "Rules Regarding Animals."

ABSTRACT

To meet the need for a method of measuring gross motor behavior as affected by various gravitational forces, a jumping device for primates was developed consisting of a large box with a stand at each end and a well in the middle. The well carried a constant electrical charge. Shock, preceded by a tone, was used to make the animal jump over the well to the opposite side. Motion pictures of the jump, as viewed through the plexiglas side and top, allowed measurement of the height and distance of the jump. Other possible uses of the device are discussed.

PUBLICATION REVIEW

This report is published for the exchange of information and stimulation of ideas.

FOR THE COMMANDER:

Walter F. Grether
WALTER F. GRETHER
Director of Operations
Aerospace Medical Laboratory

A DEVICE FOR MEASURING GROSS MOTOR BEHAVIOR IN PRIMATES

PURPOSE OF THE DEVICE

One of the problems to be considered in aero-space operations is the effect of changes in weight, resulting from variations in gravitational forces, upon gross motor responses. The facility with which man can adapt to a g condition and the length of time involved in this adaptation are important factors which influence the quality of motor performance involving the large muscle groups, such as those used in operating large controls, performing maintenance tasks, and locomoting.

To evaluate these factors a gross motor response was selected which seemed most likely to reflect the accuracy of judgements by the organism of the energy required to move from one place to another, when such movement involves opposition to the force of gravity. Jumping, which usually acts directly against any existing g force, was chosen as the response which best meets this criterion.

Measures of jumping before and after prolonged exposure on an animal centrifuge to forces higher than 1-g was chosen as a method of assessing adaptation to varying levels of g. The subjects which were to be used in these experiments were squirrel, cynomolgus, and young rhesus monkeys. In order to accurately measure the heights and distances of their jumps under controlled conditions, the Primate Jumping Device was designed and constructed.

DESCRIPTION OF THE DEVICE

The device, shown in figure 1, is 96 inches long, 26 inches wide, and 68 inches high. The back panel, the two end panels and the floor were made from 1 inch plywood, and the top and front panels were made from 5/16-inch plexiglas. Vertical and horizontal grooves were cut into the plexiglas and filled with paint to form 2-inch squares, for use as reference marks to measure the height and distance of the jumps. An 18-inch by 36-inch door in each end panel provides access to either end of the box. The lower half of each door has 9 wire screen panels to permit ventilation, the upper halves being solid because the animal could climb and cling to a wire screen in order to avoid shock. One door is of one-piece construction; the other was built in two sections, each hinged to a center piece, so that the lower section can be opened for adjustment without allowing the animal to escape.

There is a stand at each end of the box with a space in between them, termed the "well". The grids and the well were made up of 1/4-inch stainless steel rods, spaced one inch apart. Metal dropping trays can be inserted and removed without opening the doors. A speaker mounted near the ceiling at one end of the box permits the presentation of auditory stimuli to the subject. One of the stands is movable so that the width of the well can be varied. During experimentation the grids at the bottom and sides of the well were always charged, whereas the grid on either stand was only activated at the desired moment. The constant charges in the well sides discouraged the subjects from dragging their hind feet and tail in making jumps.

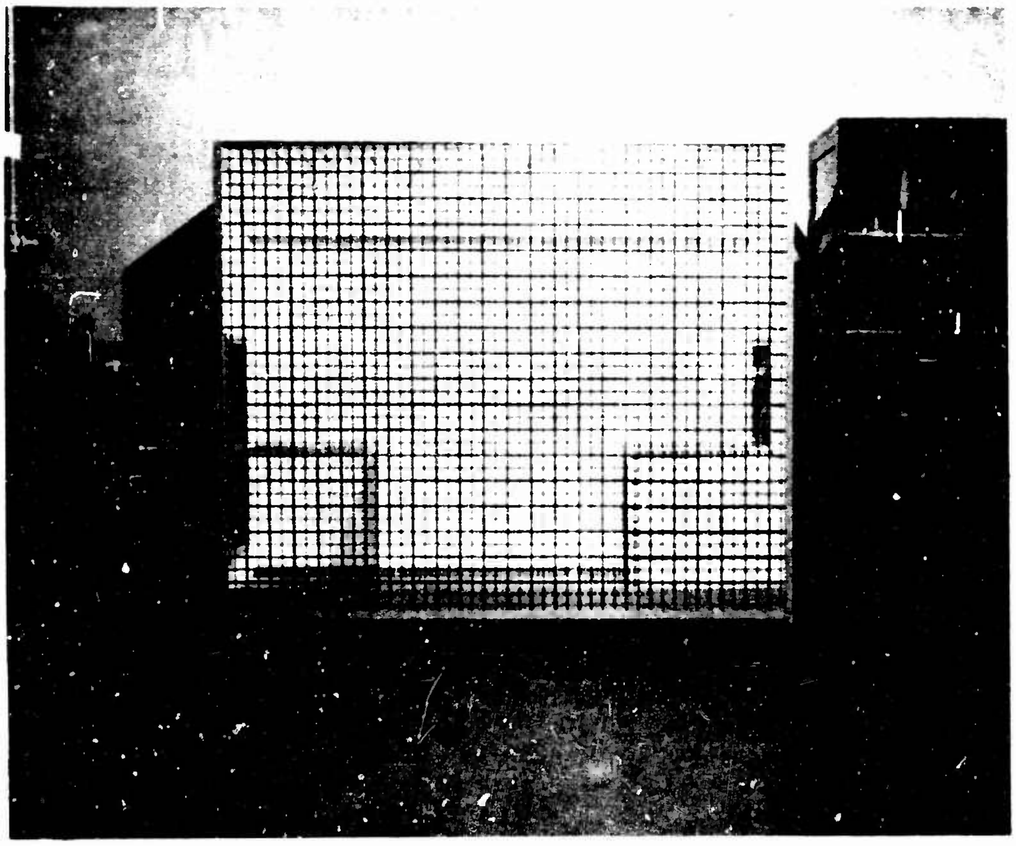

Figure 1. The Primate Jumping Device

Sixteen-millimeter motion picture cameras were mounted above and in front of the device, one in each position, to photograph the jumps. Pictures taken from the front afforded determination of the height of the jump. Those taken from above revealed (1) the distance of the jump and (2) whether the animal moved straight ahead or diagonally, the latter being referred to as "change of lane."

USE OF THE DEVICE

The training of an animal was begun with the movable stand adjusted so that the well width was only 6 inches. The width was gradually increased to 28 or 30 inches over a series of approximately 200 jumps, averaging 20 jumps each day during a 10-day period. Figure 2 shows a squirrel monkey beginning a jump.

A high frequency tone was sounded 5 seconds prior to the administration of electric shock. Early presentations were made following intervals of 30, 60, and 90 seconds which were varied randomly. Later the intervals were reduced to 20, 40, and 60 seconds, respectively.

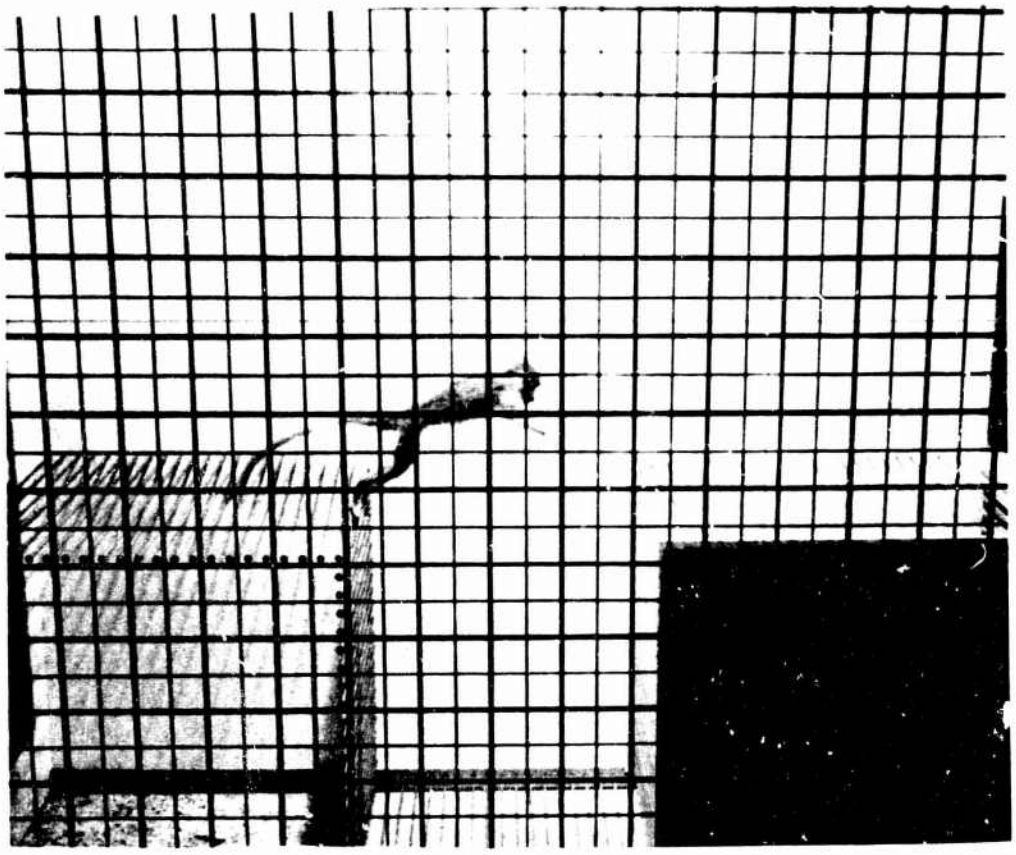

Figure 2. Jumping Squirrel Monkey

The measurements taken were response latency, height of jump, distance jumped and number of lanes changed. (Scales up the sides and along the edges of the top provided the bases for these measurements, covering the necessary three dimensions.) It was found that whereas changes of one lane were quite common, changes of more than one lane were infrequent. Lanes were 4 inches wide, and change of lane was recorded if any part of the animal reached the midpoint of any lane other than that from which it had started. With well widths of 20 to 30 inches, the correction factor necessary to compute the distance of a jump with a change of one lane did not appreciably add to the length of the jump. However, when two or more lanes were changed, a correction was made by adding the additional distance covered in diagonal jumping to the distance calculated from the scale readings. The height of the jump was determined as the highest point in the arc prescribed by the top of the animal's head. Response latency was measured by the amount of film that ran through the camera before the animal initiated movement, the camera having been started at the sound of the warning tone. Using the method described above, preliminary training has been satisfactorily accomplished with several animals but no research has as yet been done. (The device and responsibility for this research have been transferred to Aero Medical Field Laboratory at Holloman Air Force Base, New Mexico.)

OTHER POSSIBLE APPLICATIONS

The Primate Jumping Device could prove useful in a wide variety of studies where the measurement of gross motor behavior in primates is important. Such studies might include experiments on fatigue, the effects of stress on avoidance reactions, and the influence of various drugs on motor behavior. Further, it could lend assistance to longitudinal studies of motor development in primates and comparisons across species. It could be modified easily to accommodate more species, thus enhancing its flexibility and utility.